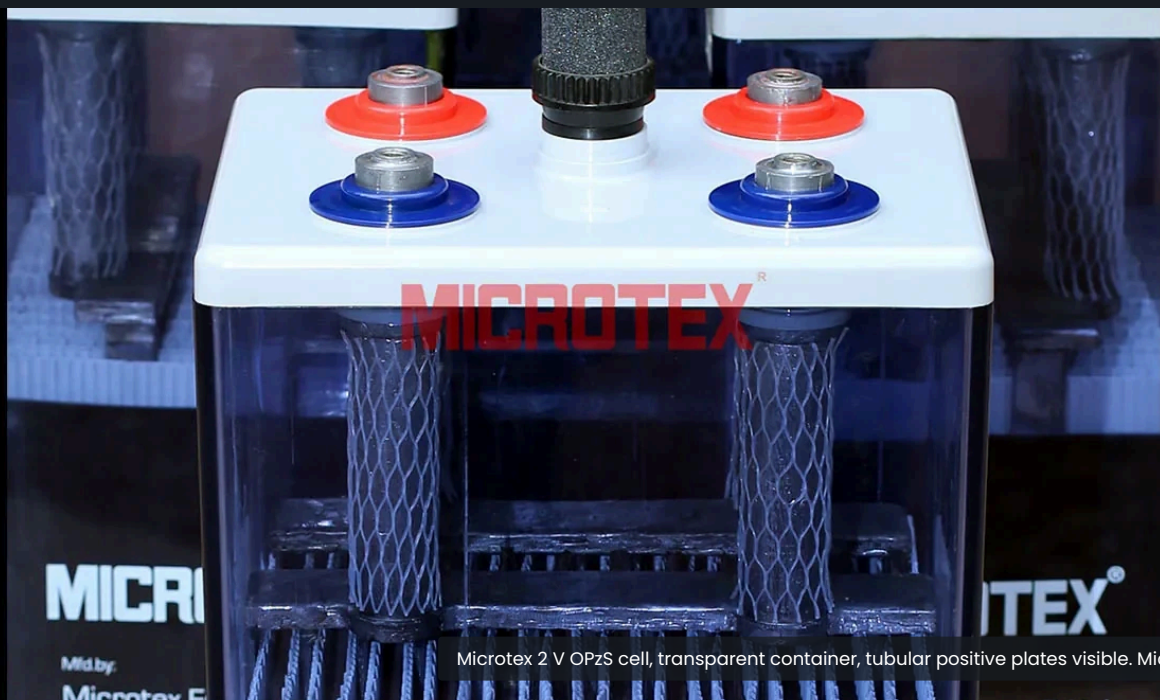


OPzS

Technical guide

Construction, cell range, electrical characteristics, sizing to IEEE 485, installation, maintenance and the information we need to quote. Written for the engineer who has to specify a station battery that will still be carrying its duty in twenty years.



60 days

Delivery for OPzS cells, every size, from order confirmation

NPCIL · BARC

Registered vendor: NPCIL · BARC · ONGC · BPCL · IOCL; 2 V tubular stationary cell type-tested to IS 1651 at CECRI, 2012

IEEE 344

Seismically qualified 2 V OPzS cells, tested at CPRI Bengaluru in 2018, NPCIL QA witness; HDP cells to IEC/IEEE 60980-344, 2026

1969

Founded in Bengaluru by Sri A. Govindan; exporting since 1977

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Who this guide is for

Design engineers, tender writers, consultants and maintenance leads at utilities, power plants, nuclear and process sites, telecom and solar operators, railways and EPC contractors. It is a working reference, not a brochure: every figure in it is either from our own type data or attributed to a named author, standard or body on page 13.

Planning note: count back from the commissioning date

An OPzS bank is built to order and leaves our works 60 days after the order is confirmed. Add transit, installation, the first charge and the acceptance test, and the enquiry should reach us about three months before the battery must be in service. A sizing reply fixes the cell type early, which is what tender schedules usually need.

AT A GLANCE

Product	2 V flooded (vented) stationary cells with tubular positive plates, DIN 40736-1 designations
Capacity range	100 to 3000 Ah nominal in seventeen catalogue types: the fourteen DIN 40736-1 sizes from 4 OPzS 200 to 24 OPzS 3000 are tabled with dimensions and weights on page 5 (C10 ratings up to 3380 Ah at 1.80 V per cell, 25 °C); 2 OPzS 100, 6 OPzS 400 and 7 OPzS 450 are in the discharge table on page 6; the Microtex 3 OPzS 150 is built in the 4 OPzS 200 container
Container	Moulded within the Microtex group; transparent SAN as standard so plates, levels and sediment can be inspected; ABS lid; material and clarity confirmed for the size ordered
Made in-house	Lead alloys, lead oxide, plates, woven gauntlets and separators are all made at our Bengaluru plant
Design life	20 years in standby float service at 27 °C on our catalogue data; the handbook survey range for tubular stationary cells is 20 to 25 years (Linden)
Charging	IU characteristic; typical float 2.23 V per cell at 25 °C. Typical values, confirm with Microtex for your installation
Standards	DIN 40736-1 designations; IEC 60896-11:2002, the type-test standard for vented stationary cells and the method behind the internal-resistance, short-circuit and cycle figures on our type datasheet; cycling endurance to IEC 61427-1:2013 on our catalogue; sizing to IEEE 485-2020; installation to IEEE 484-2019; maintenance to IEEE 450-2020; installation safety to IEC 62485-2:2010
Approvals	Registered vendor: NPCIL · BARC · ONGC · BPCL · IOCL; 2 V 800 Ah tubular stationary cell type-tested to IS 1651:1991 at CECRI, 2012; seismic qualification of our 2 V OPzS cells (IEEE Std 344-2013, 2018) and 2 V HDP cells (IEC/IEEE 60980-344:2020, 2026) at CPRI, NPCIL QA witnessed
References	BARC: a 250 V 1200 Ah bank at Trombay (ordered 2008, commissioned 2009) and a 125 V 500 Ah seismic-stand bank (ordered 2009, commissioned 2010); NPCIL Narora: two 250 V 500 Ah control banks (ordered 2012, in service 2014) — all tubular flooded, cited on page 11
Delivery	60 days from order confirmation, every size
Warranty	Standard warranty 12 months from the date of invoice; project terms on request
Contact	+91 9686 4488 99 (call or WhatsApp) · info@microtex.com · microtex.com/contact/

SECTION 1

What OPzS is, and where it is specified

A station battery is bought once and judged for two decades. The construction written into the specification decides more than the price on the first invoice, so this section explains what the four letters commit a maker to, and what duty they were designed for.

The designation

OPzS is a German designation for a stationary cell (*O*, *ortsfest*) with an armoured, tube-protected positive plate (*Pz*, *Panzerplatte*) and special separation (*S*, *Sonderseparation*), the separator system of a flooded cell. The positive active material is held in woven tubes around a cast lead-alloy spine instead of being pasted on an open grid, so it cannot fall away as the cell works. The same plate in a valve-regulated gel cell is called OPzV.

The letters also carry a dimensional standard. DIN 40736-1 defines the family of vented tubular-plate stationary cells in plastic containers: designations, capacities, main dimensions and weights. A 6 OPzS 600 from any compliant maker therefore fits the stand, the connectors and the sizing calculation written for a 6 OPzS 600 from any other, which is why utilities can second-source and spare a bank fifteen years after purchase. Type tests are set by IEC 60896-11:2002, the international standard for vented stationary lead-acid batteries.

The duty it was designed for

Years of float charge, then a few seconds of violent current and a few hours in the dark. When the AC supply fails, the DC system must pull trip coils and recharge breaker springs at many times the normal load, then carry protection relays, SCADA, communications and emergency lighting until supply returns. Flooded tubular cells suit that profile because the armoured plate survives deep, infrequent discharges, the large electrolyte reserve keeps the watering interval long, and the open construction lets a trained crew measure the true condition of every cell with a voltmeter, a hydrometer and a discharge test.

Where OPzS cells serve

APPLICATION	WHAT THE BANK DOES
Substations and grid	110 V and 220 V DC banks for switchgear tripping and closing, protection, SCADA and station lighting
Nuclear, petrochemical and heavy industry	Safety-related and station-service DC supplies where vendor approval, seismic qualification and a documented qualification file are conditions of entry
Thermal, hydro and other power plants	Emergency lighting, black-start support, turbine trip and control-room DC power
Telecom and solar	Telecom: standby float duty with occasional long discharges; solar: daily cycling — both where maintenance staff visit the site; where visits are rare, specify OPzV gel instead
Railways	Station DC supplies and signalling installations that specify flooded 2 V cells

OPzS or OPzV: a one-paragraph decision

Both use the same tubular positive plate. Choose flooded OPzS where trained maintenance exists, where the specification wants a condition that can be verified by direct measurement, and where the longest service life is the aim: utilities, power plants, substations. Choose valve-regulated OPzV gel where the room is unmanned or visits are rare: solar, telecom and remote sites. The trade is transparency and verifiable life against freedom from watering.

Interchangeability is a purchase-protection clause. Specify the DIN designation and dimensions rather than a brand, require the type-test report to IEC 60896-11 with the laboratory and report number, and any compliant maker can bid now and supply spares later.

SECTION 2

Construction

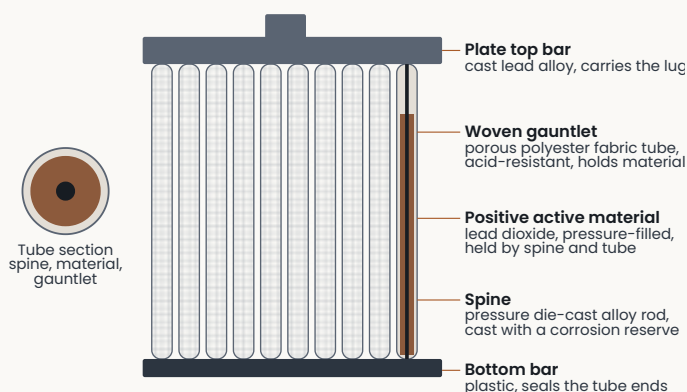


Fig. 1 Tubular positive plate, one tube cut open. Microtex drawing, not to scale.

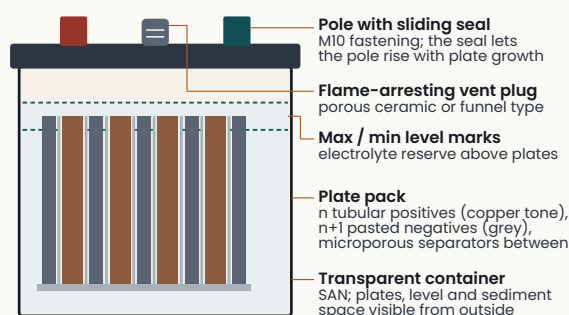


Fig. 2 Section through a 2 V OPZS cell. Microtex drawing, not to scale.

What the construction buys you

- **No shedding.** Dell and Rand describe how a pasted positive loses material on deep discharge until capacity falls or the plates short; the tubular plate is the remedy they name. Deep emergency discharges leave an armoured plate intact.
- **Designed for its own ageing.** Berndt's arithmetic: at a float corrosion rate of 0.03 mm a year, a spine loses about half its cross-section in fifteen years, so a long-life cell needs a corrosion reserve cast into the spine. Linden adds that stationary cells are dimensioned so the positives can grow by up to 10 per cent before touching the container.
- **Verifiable condition.** Level, colour and sediment are visible through the wall; density, voltage and temperature are read cell by cell; capacity is proved by a discharge test, not inferred.

What is inside the cell

Positive plate. A row of lead-alloy spines, pressure die-cast at about 150 bar, each inside a woven polyester gauntlet tube filled under pressure with positive active material and closed by a plastic bottom bar. Pressure die-casting gives the spine a fine, dense grain, which is what resists corrosion; the alloy carries grain refiners and corrosion-slowing additives, and the alloy family is stated on the type datasheet. Plates are formed at the factory, so a new cell delivers its rated capacity without conditioning cycles on site.

Negative plate. A pasted flat plate on a cast grid, with a long-life expander system in the active material. Stationary cells are built with one more negative than positive so that every positive is supported on both faces as it ages (Linden).

Separators. Microporous PVC separators made in-house, chosen for low electrical resistance and high porosity.

Electrolyte. Dilute sulphuric acid, nominal density 1.24 kg/l filled and charged at 25 °C, with a large reserve above the plates between the maximum and minimum marks. In a lead-acid cell the acid is an active material: its density falls on discharge and rises on charge, which is what makes the hydrometer a state-of-charge instrument.

Container and lid. Moulded within the Microtex group. Transparent SAN containers as standard, ABS lid in dark grey with colour-coded polarity. State your clarity preference in the enquiry; we confirm it against the size.

Pole seal. A sliding seal with rubber rings around the pole lets the pillar rise as the positive plates grow with age instead of cracking the lid, the usual way an old flooded cell ends its life; the rings also stop acid creeping up the post.

Vent plugs. Flame-arresting plugs, porous ceramic or funnel type, that let gas out, hold acid mist back and allow topping-up and density readings. Stationary batteries were the first application of flame-retardant vent caps (Linden).

Terminals and connectors. Hardened lead-alloy terminal posts with a copper insert and M10 fastening; solid copper, lead-plated flat intercell connectors with insulating shrouds.

SECTION 3

Cell range

Our catalogue covers 100 to 3000 Ah in seventeen 2 V types. The fourteen DIN 40736-1 sizes from 4 OPzS 200 to 24 OPzS 3000 are tabled here with dimensions and weights; 2 OPzS 100, 6 OPzS 400 and 7 OPzS 450 are in the discharge table on page 6; the Microtex 3 OPzS 150 is built in the 4 OPzS 200 container. Capacities at 25 °C to the end voltage shown; dimensions per single 2 V cell.

TYPE	CAPACITY, AH, AT 25 °C TO THE END VOLTAGE SHOWN					DIMENSIONS, MM			WEIGHT, KG			
	C10 1.80 V	C8 1.75 V	C5 1.77 V	C3 1.75 V	C1 1.67 V	LENGTH	WIDTH	HEIGHT MAX	DRY	FILLED	RI MILLIOHM	ISC KA
3 OPzS 150 (Microtex)	rated data confirmed at enquiry					105	208	420	at enquiry			
4 OPzS 200	210	205	175	156	114	105	208	420	12.2	17.2	0.95	2.16
5 OPzS 250	270	255	220	195	143	126	208	420	14.6	20.8	0.76	2.70
6 OPzS 300	320	304	262	234	170	147	208	420	17.2	24.3	0.63	3.24
5 OPzS 350	400	378	336	282	205	126	208	535	18.9	26.9	0.70	2.90
6 OPzS 420	490	452	400	339	245	147	208	535	22.2	31.5	0.58	3.48
7 OPzS 490	570	526	470	396	285	168	208	535	25.2	36.1	0.50	4.06
6 OPzS 600	670	657	560	474	330	147	208	710	31.9	44.8	0.47	4.32
8 OPzS 800	890	880	740	633	440	215	193	710	44.2	61.3	0.35	5.76
10 OPzS 1000	1120	1096	930	789	550	215	235	710	52.3	74.5	0.28	7.20
12 OPzS 1200	1340	1312	1100	948	660	215	277	710	62.1	88.0	0.23	8.64
12 OPzS 1500	1690	1672	1400	1200	820	215	277	855	80.4	114.3	0.23	9.18
16 OPzS 2000	2250	2232	1850	1600	1100	215	400	815	102.5	151.5	0.17	12.24
20 OPzS 2500	2810	2792	2300	2000	1375	215	490	815	129.8	193.0	0.14	15.30
24 OPzS 3000	3380	3344	2800	2400	1640	215	580	815	159.4	234.5	0.11	18.36

Reading the table

- The first number in the designation is the count of positive plates; the second is the nominal capacity in ampere-hours. The container height steps up at 350, 600 and 1500 Ah; from 2000 Ah the cell grows in width rather than height.
- C10, C8, C5, C3 and C1 are the ampere-hours delivered in 10, 8, 5, 3 and 1 hours to the end voltage in the column head, at 25 °C. Ri (internal resistance) and Isc (short-circuit current) are stated on our type datasheet as determined by the method of IEC 60896-11.
- Electrical values are nominal within ±5 per cent, dimensions within ±2 mm, weights within ±5 per cent. Dry weight is the cell dry and uncharged; filled weight is filled and charged. Either supply condition can be ordered.
- 3 OPzS 150 is a Microtex type in the 4 OPzS 200 container (our catalogue's layout drawing groups it with 4 OPzS 200 to 6 OPzS 420 and 6 OPzS 600); rated data at enquiry. Dimensions and weights of 2 OPzS 100, 6 OPzS 400 and 7 OPzS 450 are confirmed at enquiry.

Beyond the table

Discharge currents from one minute to ten hours at 1.80 V per cell, with the one-minute switchgear figure at 1.70 V per cell, are on page 6. The full catalogue set — 1.70 to 1.90 V per cell, 1 minute to 14 hours, in amperes and in watts per cell — together with the discharge curves and the capacity rating factors used in IEEE 485 sizing, is supplied with the sizing reply for the exact type. Intermediate capacities, cells below 100 Ah, BS-dimension cells and cells to a customer's rack drawing are quoted on request.

Banks are assembled from these cells at the usual system voltages: 24, 48, 110, 220 and 250 V nominal, and higher. For a 110 V bus the count is typically 54 to 56 cells; we fix the count from your voltage window (page 8).

Delivery is 60 days for every type in this table. Send the type and quantity, or send the duty and let us size it; either way the reply fixes the cell and the delivery date.

SECTION 4

Discharge currents, 1 minute to 10 hours

Constant-current discharge data from our catalogue for all seventeen types, 100 to 3000 Ah, cell at 27 °C. The one-minute columns serve switchgear tripping and closing duty, the one-hour to ten-hour columns autonomy; the sizing reply applies the rating factors for the exact type and end voltage.

TYPE	NOMINAL C10 Ah, 1.85 V/cell	1 MIN A, 1.70 V/cell	DISCHARGE CURRENT, A, TO 1.80 V/CELL							
			1 MIN	15 MIN	30 MIN	1 H	3 H	5 H	8 H	10 H
2 OPzS 100	100	108	68.3	65.1	57.4	45.0	24.6	17.7	12.3	10.3
4 OPzS 200	200	216	137	130	115	89.9	49.1	35.3	24.7	20.6
5 OPzS 250	250	270	171	163	143	112	61.4	44.2	30.9	25.7
6 OPzS 300	300	324	205	195	172	135	73.6	53.0	37.0	30.8
5 OPzS 350	350	378	239	228	201	157	85.9	61.9	43.2	36.0
6 OPzS 400	400	433	273	260	229	180	98.2	70.7	49.4	41.1
6 OPzS 420	420	454	287	273	241	189	103	74.2	51.9	43.1
7 OPzS 450	450	487	308	293	258	202	110	79.5	55.6	46.2
7 OPzS 490	490	530	335	319	281	220	120	86.6	60.5	50.3
6 OPzS 600	600	649	410	390	344	270	147	106	74.1	61.6
8 OPzS 800	800	865	547	521	459	360	196	141	98.8	82.2
10 OPzS 1000	1000	1081	684	651	574	450	245	177	123	103
12 OPzS 1200	1200	1298	820	781	688	540	295	212	148	123
12 OPzS 1500	1500	1622	1025	976	860	674	368	265	185	154
16 OPzS 2000	2000	2163	1367	1301	1147	899	491	353	247	205
20 OPzS 2500	2500	2703	1709	1627	1434	1124	614	442	309	257
24 OPzS 3000	3000	3244	2051	1952	1721	1349	736	530	370	308

Microtex OPzS catalogue, discharge-current tables at 27 °C; nominal values within ±5 per cent; the type datasheet for the cell ordered governs.

How to read the table

- Every figure is a constant discharge current in amperes per cell to the end voltage in the column head, cell fully charged and at 27 °C. Current multiplied by hours gives the ampere-hours delivered; the ten-hour column times ten comes to about 2.7 per cent above the nominal capacity.
- The one-minute column at 1.70 V per cell is the switchgear figure: the current a cell can hold for a minute while trip coils and spring-charging motors draw, without falling below the protection scheme's low-voltage setting. Fifty-five cells at 1.70 V give 93.5 V at the battery terminals, before cable drop.
- Sizing adds a temperature correction, a design margin and the 1.25 ageing factor to these figures (page 8); never size from the table alone.

Two rating bases, one range

The type table on page 5 rates C10 to 1.80 V per cell at 25 °C: 210 Ah for a 4 OPzS 200. The catalogue's discharge tables start from the nominal capacity, 200 Ah, to 1.85 V per cell at 27 °C and derive the other rates from it, so their ten-hour current is a little under one-tenth of the page 5 figure. Both are nominal values within ±5 per cent, published side by side in our catalogue; the capacity rating factors issued with the sizing reply for the exact type govern a contract.

The full set

The catalogue tables run from 1 minute to 14 hours at 1.70, 1.75, 1.80, 1.85 and 1.90 V per cell, in amperes and in watts per cell for constant-power loads such as inverters; they come with the sizing reply, together with the discharge-characteristic and charging curves.

SECTION 5

Electrical characteristics

Typical figures from our catalogue, our type data and the battery literature. Charging settings depend on the cell type, the room temperature and the charger: treat them as typical and confirm with Microtex for your installation before they go into a specification or a charger.

Discharge

Rated capacity is the 10-hour rate to 1.80 V per cell at 25 °C (page 5); the catalogue's discharge tables (page 6) work from the nominal capacity to 1.85 V per cell at 27 °C. Shorter discharges deliver fewer ampere-hours to a lower end voltage, which is why a switchgear duty of seconds and an eight-hour autonomy are sized separately and the larger result governs. Normal depth of discharge is up to 80 per cent; going beyond the end voltage for the rate, or repeatedly beyond 80 per cent, shortens life.

Open-circuit voltage and density

The open-circuit voltage follows the acid density. Linden's rule of thumb, open-circuit voltage $\approx$ density + 0.845, gives about 2.08 V for a fully charged cell at 1.24 kg/l; a rested cell reading well below that is discharged or sulphated.

Charging (typical, confirm with Microtex)

- **Characteristic:** IU (constant current, then constant voltage); the cell needs no initial current limit, the charger rating decides it.
- **Float:** typically 2.23 V per cell within ± 1 per cent across the 10 to 55 °C band our catalogue states; temperature-compensated charging outside that band, coefficient on the type datasheet.
- **Boost or equalising charge:** typically 2.35 to 2.40 V per cell, time-limited, used after a deep discharge or when cell voltages or densities have drifted apart.
- **Recharge time:** about 88 per cent of capacity back in about 6 hours at 2.23 V per cell with an initial current of $1.5 \times I_{10}$, after an 80 per cent discharge at the three-hour rate (our catalogue).
- **Ceiling:** sustained charging above about 2.45 V per cell is one of the five recurring field causes of early failure we see (page 9).

Float current, water and gas

A new OPzS cell on float draws about 15 mA per 100 Ah, rising towards 30 mA per 100 Ah at the end of life as the spines corrode. That current decomposes water: Linden's handbook puts electrolysis water loss at 0.336 cm³ per ampere-hour of overcharge, and by Faraday's law that ampere-hour is about 0.45 litres of hydrogen and 0.22 litres of oxygen at 20 °C. So topping-up with demineralised water is needed at intervals of two to three years or more at 20 °C on our catalogue data, and the room must be ventilated: hydrogen is explosive from 4 per cent by volume, and the US Bureau of Reclamation's battery manual designs to keep it below 0.8 per cent. IEC 62485-2 gives the air-flow method.

Self-discharge

About 3 per cent of capacity a month at 20 °C on open circuit (our catalogue), roughly doubling for every 10 °C rise (Linden). On float the charger replaces it; in a warehouse before commissioning it sets the freshening-charge interval.

Temperature and life

Operating range -20 to 55 °C; recommended 10 to 30 °C, which brackets the optimum Linden gives for stationary cells. Capacity falls when the electrolyte is cold. Heat accelerates corrosion of the positive spine and raises float current. Berndt's rule is that a 10 K rise doubles electrochemical reaction rates; our maintenance card says it plainly: every 10 °C hotter halves the life. The battery room is part of the purchase. Below about -5 °C the thin electrolyte of a discharged cell can freeze (Linden's Table 16.7 gives freezing points of -3.3 °C at 1.05 and -7.7 °C at 1.10 specific gravity), so cold sites keep the bank charged.

Acid stratification

On charge, heavier acid formed in the plates sinks; on discharge, lighter acid rises. A bank cycled without a gassing overcharge builds a vertical density gradient (Pavlov). The remedy is an equalising charge that gasses long enough to stir the electrolyte. Float stations rarely see it; solar and cycling installations must plan for it.

PARAMETER	TYPICAL VALUE
Electrolyte density, charged	1.24 kg/l nominal
Float voltage, 10 to 55 °C	2.23 V/cell $\pm$ 1 %, typical
Boost / equalise	2.35–2.40 V/cell, time-limited
Float current, new to end of life	15 to 30 mA per 100 Ah
Self-discharge, 20 °C	$\approx$ 3 % per month
Topping-up interval	2 to 3 years or more at 20 °C
Depth of discharge, normal	$\leq$ 80 %
Operating / recommended range	-20 to 55 °C / 10 to 30 °C
Endurance, IEC 60896-II cycle test (our type datasheet)	> 1500 cycles
Endurance, IEC 61427 cycle test (our catalogue; Part 1:2013 is the current edition)	> 3000 cycles
Design life, standby float, 27 °C	20 years

Microtex OPzS catalogue and type data, October 2026; the type datasheet for the cell ordered governs. Confirm charger settings with Microtex for your installation.

SECTION 6

Sizing, installation and commissioning

Sizing to IEEE 485–2020, in words

IEEE 485–2020 is the recommended practice for sizing lead-acid batteries for stationary float service. It tells the designer how to define the DC load and how to turn it into a cell size; it does not cover the charger or the installation. The method, in our words:

1. **Draw the duty cycle.** Every load against time for the worst credible event: the continuous loads, the momentary loads such as trip coils and spring-charging motors, and the random loads that may occur at any point. The autonomy, the hours the bank must carry the station, is a decision of the owner and the grid code, not of the battery.
2. **Fix the voltage window.** The highest voltage the connected equipment accepts, divided by the cell count, sets the maximum charging voltage per cell; the lowest system voltage the equipment tolerates, after cable drop, divided by the cell count, sets the end-of-discharge voltage per cell. The cell count is chosen so that both are satisfied.
3. **Size section by section.** The duty cycle is cut into periods. For each period the current is converted into a cell size using the capacity rating factor of the cell type for that duration and end voltage, and the sections are accumulated; the largest total governs, because a later heavy load must still be carried after an earlier one has taken its share.
4. **Apply the corrections.** A temperature correction for the lowest electrolyte temperature expected; a design margin for load growth and uncertainty, commonly 10 to 15 per cent; and an ageing factor of 1.25, so that the bank still carries the full duty when it has worn to 80 per cent of rated capacity, the point at which the US Bureau of Reclamation's manual, like utility practice generally, says a battery is worn out and should be replaced.
5. **Select the next larger cell** and check the recharge time against the charger rating and the owner's requirement.

Our own sizing sheet applies exactly this sequence with the capacity rating factors of our tubular types at 27 °C, the Indian reference temperature. Send the duty data on page 12 and the calculation comes back with the cell type, the count and the factors shown, ready to attach to a tender.

Installation, to IEEE 484–2019 practice

IEEE 484–2019 is the recommended practice for the installation design and installation of vented lead-acid stationary batteries: storage, location, mounting, ventilation, instrumentation, assembly and the first charge, with the safety practices that go with them. IEC 62485–2:2010 sets the safety requirements for stationary battery installations up to 1500 V DC: protection against electric shock, gas and electrolyte, through erection, use, inspection, maintenance and disposal. What they ask for, in our words, and what we add:

- **The room.** Cool (10 to 30 °C), dry, ventilated to the hydrogen calculation, with an acid-resistant floor, eyewash and personal protection, no ignition sources, and clearances for a hydrometer and a torque wrench at every cell.
- **Receipt and storage.** Inspect on arrival; keep cells upright and out of sunlight. Filled and charged cells should receive their freshening charge within the storage period on the datasheet; dry-uncharged cells are filled with acid of the specified density and given the commissioning charge in the manual. A battery stored longer than three months is treated as needing a freshening charge before test (Bureau of Reclamation practice).
- **Racks and connections.** Level, insulated stands in steel, galvanised steel, FRP or hardwood (sal or teak) with acid-resistant paint, single or double tier, stepped where the room needs it; seismically qualified by analysis or test where the site requires it, as in the OPzS steel-stand configuration tested at CPRI in 2018. Number every cell, check polarity, clean the contact faces, torque connectors to the datasheet value, fit the insulating shrouds.
- **First charge.** Charge at the commissioning voltage in the manual until every cell gasses evenly and the density and voltage readings stop rising; then record the voltage, density and temperature of every cell as the baseline of the logbook.
- **Acceptance test.** A timed discharge at the rated rate to the end voltage, per IEEE 450–2020, proves the delivered capacity at hand-over. We offer factory acceptance testing with the customer's witness before despatch.

Timing. Build 60 days, then transit, installation, first charge and acceptance. If the commissioning date is fixed, the enquiry should reach us about three months before it.

SECTION 7

Maintenance

A flooded cell tells you its condition if you ask. Our catalogue sets the minimum: a six-monthly check of battery voltage, pilot-cell voltage and temperature, and a yearly record of every cell voltage and temperature. The four-level schedule below is what we teach at our maintenance lectures; IEEE 450-2020 sets the inspection intervals, the test schedule and the replacement criteria that utilities write into their procedures, and your O&M manual governs where the two differ.

The schedule: four inspection levels

LEVEL	WHAT IS DONE
Daily	Walk past: leaks, dirt, low electrolyte levels, charger alarms, float voltage and current on the panel.
Monthly	Pilot cells: voltage, specific gravity, temperature. Overall float voltage and current. Write the numbers down.
Quarterly	All cells: the same three readings. Compare each cell against last quarter and against its neighbours.
Yearly	Capacity test (timed discharge). Connection torque check. Clean and lightly grease terminals. Review the whole log for trends.

House rules

- **Demineralised water only.** Never add acid, never overfill. Add water after a recharge, before an equalising charge, so gassing stirs it in (Linden).
- **Correct specific gravity readings to 27 °C.** Uncorrected readings mislead; the coefficient is about 0.0007 per °C: add for readings taken above the reference temperature, subtract below (Linden's table).
- **Keep the room cool.** Every 10 °C hotter halves the life.
- **Keep cell tops clean and dry.** Dirt plus moisture builds leakage paths. Neutralise spilt electrolyte with bicarbonate of soda solution and rinse (Linden).
- **Ventilate.** Hydrogen discipline: no flames, no sparks, no smoking, fans checked.
- **Equalise to the datasheet,** when the voltage or density spread widens. Stop when readings have been steady for several hours, the test Vinal set down in 1955 and still the right one.

Reading the numbers

OBSERVATION	LIKELY MEANING AND ACTION
Density falling, voltage normal	Chronic undercharge. Check the charger setting and the float current, then equalise.
Cell-voltage spread widening	The bank is drifting apart. Time for an equalising charge; then watch the outliers.
Water consumption rising	Float voltage probably set too high, or the room is hotter. Investigate before topping up.
One cell warmer than its neighbours	Internal fault or a high-resistance connection. Measure the connection and the cell; do not wait for the yearly test.
Capacity test below 80 % of rated	The bank is worn out by the Bureau of Reclamation's criterion; plan replacement, allowing 60 days build.

Five recurring field failure causes

1. The wrong type for the duty (a float cell cycled daily, or a cycling duty with no equalising).
2. No incoming check: cells installed and floated without a baseline record.
3. The wrong charger, or the right charger set wrongly.
4. Charging above about 2.45 V per cell for long periods.
5. A new cell placed among old cells without matching it to the string.

The logbook is primary maintenance evidence. Record every reading. Verify the float voltage and the temperature compensation at every visit. A bank with a complete log can usually be diagnosed from the log by email; a bank without one can only be diagnosed on site.

SECTION 8

Standards, approvals, testing, warranty, delivery

The standards a stationary-battery specification leans on

Numbers verified and titles quoted as published by the issuing bodies (IEC webstore, IEEE SA, DIN Media) on 13 October 2026; the IS 1651 title is as listed by standards retailers and is to be confirmed with BIS. Summaries are our own words, not clause text.

STANDARD	TITLE	WHAT IT ASKS FOR, IN OUR WORDS
DIN 40736-1:2015-09	"Lead acid batteries – Part 1: Stationary vented cells with positive tubular plates in plastic-containers" (DIN)	Defines the OPzS family: designations, capacities, main dimensions and weights, so cells from different makers interchange.
IEC 60896-11:2002	"Stationary lead-acid batteries – Part 11: Vented types – General requirements and methods of tests" (IEC)	The type tests for vented stationary cells, among them capacity, endurance in cycles, internal resistance and short-circuit current. Ask for the report with laboratory and report number. Our type datasheet states its internal-resistance, short-circuit and cycle-endurance figures by this standard's methods.
IEC 61427-1:2013, edition 1.0	"Secondary cells and batteries for renewable energy storage – General requirements and methods of test – Part 1: Photovoltaic off-grid application" (IEC)	Test methods for cells in off-grid solar storage; the cycling endurance test behind our catalogue's > 3000-cycle figure (page 7).
IEEE 485-2020	"IEEE Recommended Practice for Sizing Lead-Acid Batteries for Stationary Applications" (IEEE)	How to define the DC duty cycle and size the bank for float service, with temperature, design-margin and ageing corrections (page 8).
IEEE 484-2019	"IEEE Recommended Practice for Installation Design and Installation of Vented Lead-Acid Batteries for Stationary Applications" (IEEE)	Storage, location, mounting, ventilation, assembly, first charge and the safety practices around them.
IEEE 450-2020	"IEEE Recommended Practice for Maintenance, Testing, and Replacement of Vented Lead-Acid Batteries for Stationary Applications" (IEEE)	Inspection intervals, capacity-test schedule and procedure, and when to replace. A revision (P450) is in progress.
IEEE 535-2022	"IEEE Standard for Qualification of Class 1E Vented Lead Acid Storage Batteries for Nuclear Power Generating Stations" (IEEE)	How a vented lead-acid battery and its rack are qualified for safety-class duty outside containment; separate paths for duty cycles up to and beyond 8 hours.
IEEE 344-2013	"IEEE Standard for Seismic Qualification of Equipment for Nuclear Power Generating Stations" (IEEE)	Test and analysis methods proving equipment performs through operating-basis and safe-shutdown earthquakes. Basis of the 2018 CPRI test of our OPzS cells; IEEE lists IEEE/IEC 60980-344:2020, the basis of the May 2026 HDP test, as its successor.
IEC 62485-2:2010, edition 1.0	"Safety requirements for secondary batteries and battery installations – Part 2: Stationary batteries" (IEC)	Protection against shock, gas and electrolyte for installations up to 1500 V DC: room, ventilation, erection, use, inspection, maintenance, disposal.
IS 1651 (edition to be confirmed)	Stationary cells and batteries, lead-acid type (with tubular positive plates) – title as listed by retailers; our catalogue cites IS 1651-1993 and the CECRI report IS 1651:1991; edition and status to be confirmed with BIS	The Indian Standard Indian tenders cite for this cell type; our 2 V 800 Ah tubular stationary cell was type-tested to the 1991 edition at CECRI in 2012 (below). Confirm the edition in force with BIS at tender stage; we quote against the edition named.

Approvals and testing we hold

- **Registered vendor:** NPCIL · BARC · ONGC · BPCL · IOCL; registration documents supplied with tender documents.
- **Type test:** a Microtex 2 V 800 Ah tubular stationary cell to IS 1651:1991 at CECRI, Karaikudi, 2012 – dimensions, capacity, storage loss, endurance, Ah and Wh efficiency, discharge voltage; report with tender documentation.
- **Seismic qualification:** 2 V OPzS cells in their steel stand, resonance search, OBE and SSE per IEEE Std 344-2013 at CPRI Bengaluru, 2018, NPCIL QA witnessed (report CPRI BLREVR C18T0116, held by Mysore Thermo Electric Pvt Ltd, a Microtex group company); 2 V HDP cells to IEC/IEEE 60980-344:2020 at CPRI, May 2026 (report CPRI BLREVR C26T0049; page 11).
- **Factory acceptance test** with the customer's witness; full tender file: GTP, drawings, O&M manual, sizing calculation, deviation statement.

Reference installations, worded as the customers' documents state them: page 11.

Warranty

Standard warranty: 12 months from the date of invoice. Project terms on request and in the offer.

Delivery

60 days from order confirmation for every type in the range, ex-works Bengaluru. Export consignments are packed in plywood cases; UN packaging-certificate details on request; filled-and-charged or dry-uncharged supply is agreed at order.

Dates and conditions

Facts as of October 2026. Approvals and test reports are supplied as copies with the offer or tender, valid as stated on the documents. Specifications are subject to confirmation on the type datasheet for the cell ordered.

Vendor standing, October 2026

Registered vendor: NPCIL · BARC · ONGC · BPCL · IOCL – registration documents supplied with tender documentation

SECTION 9

Reference installations

The nuclear and public-sector banks we can cite, worded as the customers' documents and our purchase orders state them. Each carries its year: these are facts on file, not claims about what a bank is doing today.

BHABHA ATOMIC RESEARCH CENTRE, TROMBAY

250 V 1200 Ah tubular flooded battery bank

Microtex tubular flooded stationary cells in transparent SAN containers, on a seismically qualified stand. Ordered March 2008; supplied by the Microtex group through Mysore Thermo and delivered March 2009; installed and commissioned May 2009, certified complete and in operation by BARC's Research Reactor Maintenance Division.

Performance certified satisfactory by the same division, April 2011.

Purchase order of March 2008, work completion certificate of July 2009 and performance certificate of April 2011 on file.

BHABHA ATOMIC RESEARCH CENTRE

125 V 500 Ah tubular flooded bank, seismically qualified stand

Microtex tubular flooded stationary cells with a seismically qualified steel stand, replacing an earlier 500 Ah bank. Ordered October 2009; supplied by the Microtex group through Mysore Thermo and installed, tested and commissioned by November 2010 (BARC Research Reactor Maintenance Division note).

Initial performance reported satisfactory by BARC's Research Reactor Maintenance Division, November 2010.

Purchase order of October 2009 and completion note of November 2010 on file.

A GOVERNMENT OF INDIA ALUMINIUM SMELTER, ANGUL, ODISHA

2 V 400 Ah flooded stationary cells, 55-cell set

Microtex 2 V 400 Ah flooded stationary cells in transparent SAN containers with ABS lids, supplied dry-uncharged with electrolyte. Ordered from the Microtex group through Mysore Thermo, March 2013; delivery scheduled July 2013 on the order.

Purchase order of 30 March 2013 on file: a supply record, not a performance letter.

NUCLEAR POWER CORPORATION OF INDIA, NARORA ATOMIC POWER STATION

Two 250 V DC 500 Ah control battery banks, Unit 1

Microtex tubular flooded stationary cells in SAN containers, 120 per bank, on metallic stands — supplied by the Microtex group through Mysore Thermo, 2012 (purchase order of January 2012); installed, tested and commissioned September–November 2014 and put into service October–November 2014 (NPCIL completion certificate).

Purchase order of January 2012 and completion certificate of November 2014 on file.

Vendor standing, October 2026

Registered vendor: NPCIL · BARC · ONGC · BPCL · IOCL — registration documents supplied with tender documentation

Seismic qualification: 2 V OPzS cells (6 OPzS 300) in their steel stand — resonance search, OBE and SSE per IEEE Std 344-2013 at CPRI Bengaluru, 2018, NPCIL QA witnessed (report CPRI BLREVRC18T0116, held by Mysore Thermo Electric Pvt Ltd, a Microtex group company). Our 2 V HDP stationary cells, the same tubular-plate family as OPzS, were further qualified to IEC/IEEE 60980-344:2020 at CPRI in May 2026 — five OBE and one SSE at 10 per cent above the required spectrum, discharging without interruption, no damage, no acid spillage, NPCIL QA witnessed (report CPRI BLREVRC26T0049). Registrations, report numbers and ULRs travel with tender documentation.

How these references are worded

The purchase orders describe the cells as lead-acid stationary cells — tubular where the order says so — and this page uses those words, never a DIN designation. Capacities, voltages and dates are taken from the customer's certificate or the order, never from a file name. Satisfactory is the customer's word; nothing stronger is claimed.

Railway coach and telecom exchange references are VRLA banks and are published with those ranges, not here.

The certificates and purchase orders behind this page are on file at Microtex. Letters more than fifteen years old are cited with their year.

SECTION 10

How to request a quotation

Three routes, one engineering team. Enquiries are acknowledged the same working day and answered by a stationary-battery engineer. Office hours Monday to Saturday, 9:00 to 18:00 IST.

CALL OR WHATSAPP

+91 9686 4488 99

WhatsApp Business account. Send a photo of the existing nameplate or the tender page and we reply on the thread.

EMAIL

info@microtex.com

Attach the tender annexures, the single-line diagram or the existing battery datasheet.

WEB FORM

microtex.com/contact/

Choose "OPzS — utility / substation / power plant" and attach the specification (PDF, up to 8 MB).

What to send: the sizing data

- ☐ DC system nominal voltage and the voltage window the loads accept (maximum and minimum)
- ☐ Continuous loads, in amperes, and for how long
- ☐ Momentary loads: trip coils, spring-charging motors, inrush, with their durations
- ☐ Autonomy required, in hours (or the generator start time)
- ☐ Battery-room temperature: normal and lowest expected
- ☐ End-of-discharge voltage the protection scheme allows, if known
- ☐ Preferred cell count or rack layout, if constrained by an existing stand

Or, if you already know the cell

- ☐ Type designation (for example 10 OPzS 1000) and quantity, or the existing nameplate photo
- ☐ Rack: existing drawing, or whether a new stand is required (steel, galvanised, FRP or hardwood; standard or seismic)
- ☐ Supply condition: filled and charged, or dry-uncharged with acid

For tenders and projects

- ☐ Standards and approvals called for, and the edition named
- ☐ Seismic or nuclear qualification requirement (IEEE 344 or IEC/IEEE 60980-344, IEEE 535)
- ☐ Country, site, and the required delivery and commissioning dates
- ☐ Documentation required: GTP, type-test reports, O&M manual, FAT witness
- ☐ Accessories: racks, connectors, hydrometer, thermometer, spare cells

What comes back

- The sizing calculation to IEEE 485 on your duty, with the factors shown
- Cell type, count, bank voltage window, and the type datasheet
- General-arrangement drawing of cells and stand; weights for the floor loading
- Commercial offer: ex-works price, 60-day delivery, 12-month standard warranty, packing
- On request: type-test reports, vendor registrations, the seismic qualification file, a deviation statement against your specification

If another construction would serve you better, for an unheated kiosk or an unmanned site, we say so in the reply rather than quote OPzS regardless.

SECTION 11

Sources and legal

Works consulted and cited

Everything in this guide is written in our own words from our own understanding and from the sources named here. Where a figure or a finding is taken from a source, the author or issuing body is named at the point of use. No text, table layout or figure has been reproduced from any of them.

T. B. Reddy (ed.), *Linden's Handbook of Batteries*, 4th edition, McGraw-Hill, 2011: chapter 16 (lead-acid batteries), sections 16.6 (stationary batteries: construction and performance) and 16.8 (charging and maintenance): plate growth allowance, flame-retardant vent caps, n+1 negatives, optimum temperature, self-discharge and its temperature dependence, life survey by plate type, float charging, the electrolysis water-loss rate per ampere-hour of overcharge, water addition, cleaning, the open-circuit-voltage approximation and the specific-gravity table with its temperature coefficients and freezing points.

D. Berndt, "Electrochemical Energy Storage", chapter 1 of *Battery Technology Handbook*, 2nd edition, Expert Verlag / Marcel Dekker, 2003: positive-grid corrosion rates on float, the corrosion reserve, and the temperature rule for reaction rates.

R. M. Dell and D. A. J. Rand, *Understanding Batteries*, Royal Society of Chemistry, 2001, chapter 8: paste shedding of pasted positives and the tubular-plate remedy; stationary and standby duties; tubular standby cells with flame-arresting vents.

D. Pavlov, *Lead-Acid Batteries: Science and Technology*, Elsevier, 2011, chapters 1, 2 and 3: antimony, hydrogen evolution and water loss; the tubular-plate manufacturing sequence; the mechanism of acid stratification.

G. W. Vinal, *Storage Batteries*, 4th edition, Wiley, 1955, chapter on operation: equalising charges and when to end them.

A German stationary-battery maker's application-engineering handbook on stationary lead-acid batteries, Part 1, 3rd edition, December 2008 (held on our shelf): consulted for the expansion of the OPzS designation and for background on tubular-plate construction; no figure in this guide is taken from it.

U.S. Department of the Interior, Bureau of Reclamation, *FIST Volume 3-6: Storage Battery Maintenance and Principles*, April 2020 (public domain): the 80 per cent replacement criterion, the freshening charge after storage, hydrogen limits for ventilation design, and the room-temperature guidance.

Microtex Energy Private Limited: the Microtex OPzS catalogue, Standby-Power OPzS series, 100 to 3000 Ah (2019 printing, file revised 2021): type table, discharge-current and discharge-power tables at 27 °C, specifications, maintenance intervals and rack options; the OPzS type datasheet of 2014 (same type table); the OPzS maintenance card from our NPCIL lecture of 3 August 2026; the Microtex battery sizing sheet; the microtex.com OPzS product page and home page, October 2026; the customer certificates and purchase orders on file behind page 11; the CECRI test report of 20 February 2012 (Central Electrochemical Research Institute, Karaikudi) on the 2 V 800 Ah cell, behind page 10.

Standards, verified at the issuing bodies on 13 October 2026: DIN 40736-1:2015-09 (DIN Media); IEC 60896-11:2002, IEC 61427-1:2013 and IEC 62485-2:2010 (IEC webstore); IEEE Std 485-2020, 484-2019, 450-2020, 535-2022 and 344-2013 (IEEE Standards Association); IS 1651 (number on our known-correct list; the 2012 CECRI report names the 1991 edition; edition and title to be confirmed with the Bureau of Indian Standards at tender stage).

Document control

Microtex OPzS Technical Guide, Edition 1, October 2026 (revision 8, 15 October 2026). Restates the OPzS catalogue and the 2014 OPzS type datasheet for descriptive purposes; the type datasheet remains the contractual document for each cell type.

Conditions of use. Facts as of October 2026. All specifications, capacities, dimensions, weights and charging values are typical and subject to confirmation on the type datasheet and in the offer for the cell ordered; they do not form part of any contract unless expressly incorporated. Charging settings must be confirmed with Microtex for the installation concerned. Standards are cited by number, year and title for reference; the user is responsible for confirming the edition required by the purchaser or regulator. Approvals and test reports are available as copies on request and are valid as stated on the documents themselves. OPzS and OPzV are generic DIN designations. Microtex and the Microtex logo are trademarks of Microtex Energy Private Limited. © 2026 Microtex Energy Private Limited, 42, 2nd Main, 2nd Phase, Peenya Industrial Area, Bengaluru 560058, India. GSTN 29AABCM1510D1Z2 · CIN U71220KA1977PTC003190.